AMERICAN
DYESTUFF REPORTER

VOLUME XXIII | DECEMBER 3, 1934 | NUMBER 25

Dyeworks Effluent Purification

Some Notes on a Purification Plant Which Gave Satisfaction

By A. J. HALL, B.Sc., F.I.C., F.T.I.

THE effluent of a dyeing works is nearly always of a complex nature. In this case the main operations carried on were bleaching, mercerizing, cotton and rayon dyeing, Aniline Black dyeing by the prussiate method, and finishing of the dyed fabrics. Thus in addition to the usual chemicals and dyes likely to be found in a dyeworks effluent there were aniline and prussiate of soda (from Aniline Black dyeing), and starches, glucose, and gums (from the finishing).

In the literature it is sometimes stated that because a dyework's effluent contains so many various substances it is the easier to deal with, this view being apparently based on the expectation that the numerous impurities will precipitate each other and thus tend to leave an effluent substantially pure. Unfortunately no reliance can be placed on this convenient inter-precipitation of impurities for the processes being carried out in the dyeworks are intermittent. According to the state of trade, certain operations may not be carried out for days or even weeks at a time while others may be extended over their normal period in order to cope with extra demands. The purification system must therefore allow for these changes in the character of the effluent.

One further point with regard to effluent purification demands consideration. Whenever possible, the treatment adopted should yield products capable of being sold as useful for manufacture into other products or of being regenerated into substances which can be used again in the dyeing or finishing. Thus in the purification of soap scouring liquors as obtained in wool dyeing works it has been found possible to dispose profitably of the recovered fatty substances.

Some few years ago the writer was concerned with a works carrying on bleaching and dyeing and which had to empty its effluent into a somewhat small stream without polluting it sufficiently to injure fish life or cause annoyance to neighboring industrial users. This problem of effluent purification is one which confronts other dyeing works and for this reason it is thought that some details of the methods of purification which were successfully employed in this one instance may be helpful to other works. It is not claimed that the purification system used is the only one which would prove satisfactory but merely that it was actually found to yield an effluent having satisfactory characteristics.

In devising a purification plant for the effluent here under consideration in this article it was thought that an attempt should be made to recover the sodium ferrocyanide used in the Aniline Black dyeing. The plant was therefore laid out so that the effluent from this section of the works could be treated separately and then (after purification) run into the main effluent.

In Fig. 1 is shown the main layout of the purification plant. The effluent from the works is made up of two separate streams S (from the Aniline Black dyeing plant) and T (from all other parts of the works). Effluent S is led through a preliminary purification plant consisting of tanks A and B where it is freed from all prussiate of soda (this substance is actually precipitated with copperas to form Prussian Blue) and it therefore joins the main effluent T to enter the main purification plant consisting of tanks C, D, E, F, G, and H. Afterwards, the effluent substantially freed from obnoxious chemicals and suspended matters passes through the aeration plant consisting of percolators J, K, and M, and then to the sedimentation plant (tanks N, O, P, and Q) where it is finally freed from suspended matters and discharged into the stream R as a purified effluent. W is a filter press plant for dealing with the sludge of precipitated impurities collected from different parts of the purification system and also for dealing with the Prussian Blue by-product resulting from purification of the effluent S. This purification plant occupies a considerable area but by skillful arrangement of the various parts of the plant the whole could be worked by two men and much of the pumping which otherwise would be required was reduced by gravity flows made possible by building the plant on sloping land.

Attention will first be directed to the purification of the effluent from the Aniline Black dyeing plant. It will be remembered that in this dyeing process cotton fabric is first impregnated with a mixture of aniline, hydrochloric acid, sodium ferrocyanide, and sodium chlorate, then dried, aged in the presence of steam, and afterwards oxidized with a dilute solution of sodium bichromate; finally the fabric is washed free from all soluble substances and dried. This dyeing process is carried out continuously so there flows from the plant a constant stream of washing water containing prussiates, acid, and decomposition products of the sodium chlorate and aniline.

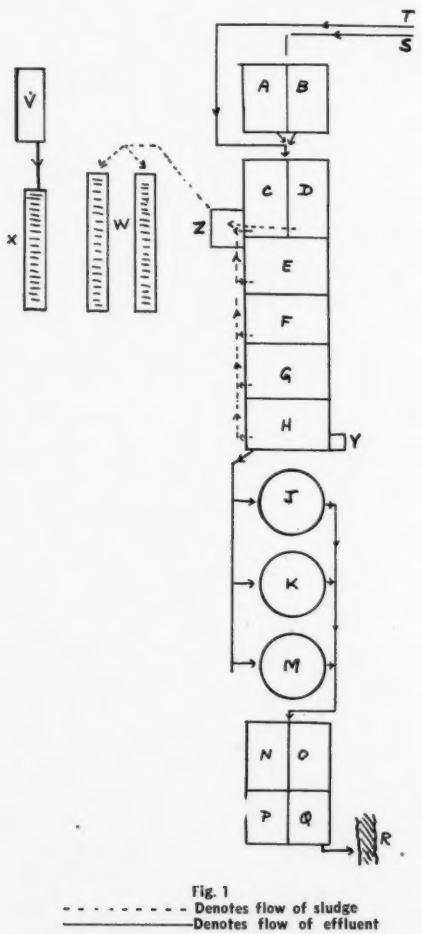

Fig. 1
- - - - - - - - - Denotes flow of sludge
——————Denotes flow of effluent

Considered theoretically the content of the impregnating mixture should undergo the following changes:

Sodium chlorate ⟶ Sodium chloride and oxygen (this latter is absorbed by the aniline and thereby changed to insoluble Aniline Black pigment).

Hydrochloric acid ⟶ Reacts with sodium chlorate to form mainly sodium chloride.

Aniline ⟶ Oxidized to insoluble Aniline Black pigment.

Sodium ferrocyanide ⟶ Acts as a catalyst. It is partly changed to sodium ferricyanide and Prussian Blue (this latter is insoluble and is therefore retained by the cotton fabric).

It is found in practice that the washing liquor contains mainly sodium ferricyanide and sodium chloride together with smaller amounts of hydrochloric acid, chromium chloride (from the sodium bichromate), and sodium ferrocyanide. This allows a comparative simple recovery of the sodium ferrocyanide and ferricyanide in the form of Prussian Blue, and this latter may be simply reconverted into sodium ferrocyanide suitable for use again in the Aniline Black dyeing process. The purification method described here is therefore not only of interest to those concerned with effluent purification but also to Aniline Black dyers, for it is possible that the purification method may prove profitable as a means of recovering the sodium ferrocyanide.

The essential feature of the purification treatment of the washing liquor consists of precipitating both the sodium ferrocyanide and ferricyanide by the addition of a solution of Copperas (ferrous sulfate containing ferric sulfate as impurity) whereby the following reactions take place.

1. $2Na_3FeCy_6 + 3FeSO_4 = Fe_3(FeCy_6)_2 + 3Na_2SO_4$
   Sodium ferricyanide — Turnbull's Blue
2. $3Na_4FeCy_6 + 2Fe_2(SO_4)_3 = Fe_4(FeCy_6)_3 + 6Na_2SO_4$
   Sodium ferrocyanide — Prussian Blue

Both Prussian Blue and Turnbull's Blue are insoluble in water and readily separate as a very voluminous precipitate so that by utilizing these reactions it is possible to free the washing liquor completely from prussiates.

Suitable plant for treating the washing liquors as indictated above is shown in Fig. 2. A and B are two adjacent brick tanks of large capacity (about 10,000 gallons) each having a bottom which slopes towards its center and a swivelling pipe P. T is a tank containing a concentrated solution of copperas slightly acidified with sulfuric acid (this prevents the formation of a basic iron sulfate sediment) which is allowed to flow at a suitable rate into A or B as desired. The washing liquor from the Aniline Black dyeing plant is allowed to enter at the back of tank A or B and flow forward to the front of the tank where it spills over a ledge into the main effluent. As it enters the tank it is met with a small flow of the copperas solution and immediately the prussiate is precipitated as Prussian Blue and Turnbull's Blue; baffle boards in the tank ensure adequate mixing of the two liquors and the size of the tank is sufficiently large to produce but a slow flow of liquor through it. Thus by the time the liquor reaches the front of the tank the precipitate has settled towards the bottom of the tank so that it is quite clear liquor which spills over into the main effluent.

After tank A has been in use for one day the treatment is transferred to tank B where the same processes take

place. Meanwhile, after a few hours of settling the clear supernatant liquor in tank A is run into the main effluent through swivel pipe P (this can be gradually lowered so that it does not pass any of the Prussian Blue precipitate). The residual thick gelatinous precipitate of Prussian Blue is then pumped up into tank V which is about 30 to 40 feet above ground level. This precipitate is then allowed to gravitate down through a wide pipe (4 inches in diameter) into a filter press X; the filtrate is allowed to flow into the main effluent while the Prussian Blue paste (about 25% of dry solids) is then ready for further treatment.

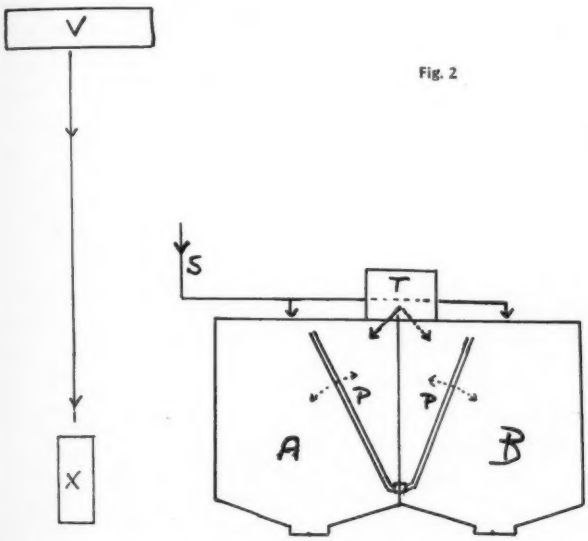

Fig. 2

After tank A has been emptied of Prussian Blue precipitate it can be used again while tank B is run off and its content of precipitate pumped up into tank V. In this manner tanks A and B are alternatively used for precipitation of the Prussian Blue.

Turning now to the filtered Prussian Blue precipitate it might be anticipated that this could be directly used as for the manufacture of a cheap blue paint. This, however, is not practicable for the simple yet curious reason that the dried precipitate has very little tinctorial power. The fact is that for a Prussian Blue to have good tinctorial power it must be precipitated under special and suitable conditions, and apparently these do not obtain in the purification method here described. Attempts to produce a precipitate suitable for paint manufacture by varying the conditions of treatment in tanks A and B were all found to be unsuccessful. The precipitate must, therefore, be decomposed for regeneration of sodium ferrocyanide.

It is a curious fact that although Prussian Blue and Turnbull's Blue are made from sodium ferrocyanide and ferricyanide, respectively, both of these compounds yield sodium ferrocyanide when treated with caustic soda or hot soda ash. These changes are shown below:

$Fe_3(FeCy_6)_2 + NaOH \longrightarrow Na_4FeCy_6 + Fe(OH)_3$
Turnbull's Blue — Sodium ferrocyanide

$Fe_4(FeCy_6)_3 + NaOH \longrightarrow Na_4FeCy_6 + Fe(OH)_3$
Prussian Blue — Sodium ferrocyanide

The conversion of the blue precipitate into sodium ferrocyanide and brown iron oxide as shown above takes place with extreme ease so that it is unnecessary to heat the mixture more than a short time. The product is then filtered through a press and the filtrate (a solution of sodium ferrocyanide) evaporated and allowed to crystallize. All residual liquors obtained in this process are reprecipitated with copperas and added to the blue precipitate obtained in the washing liquor purification treatment so that no prussiate need be wasted. The residue of iron oxide is available for sale to paint manufacturers since it has useful tinctorial properties.

An economy may sometimes be effected in the recovery process by omitting the final crystallization. It is possible to evaporate the sodium ferrocyanide solution until it is of such strength that it can be used directly in the preparation of the Aniline Black impregnating liquor. Under these circumstances it is essential that the solution contains no colloidal iron oxide (this is sometimes liable to pass through the filter press) for then, on being mixed with the aniline and hydrochloric acid, there is immediately formed a blue precipitate. With careful filtration, however, this difficulty can be avoided and the cost of evaporation saved.

In practice it is found that on balancing the amount of sodium ferrocyanide initially used in the dyeing process with the amount recovered that there is a loss of about 40 to 50%. This is accounted for by the fact that a considerable amount of Prussian Blue is formed in the fabric during the formation of Aniline Black. This Prussian Blue is strongly retained by the fabric and is thus lost. It would seem, in fact, that part of the pleasing bluish shade of the black obtained in the prussiate Aniline Black dyeing process is due to the presence of Prussian Blue in the Aniline Black pigment. If the fabric is treated with dilute caustic soda solution, the Prussian Blue present is decomposed with formation of iron oxide and sodium ferrocyanide. The last named substance can be washed out with water, and the iron oxide then removed by treatment of the fabric with dilute warm hydrochloric acid followed by washing with water. It is then found that the fabric has quite a drab appearance, quite unlike the good black color which it showed before removal of the Prussian Blue. By estimation of the amount of Prussian Blue in the dyed fabric it can be shown that a 50% recovery of sodium ferrocyanide is about the limit that can be expected.

The cost of recovering the sodium ferrocyanide is comparatively small because most of the processes involved are carried out without additional heating of the liquors and because the filtration is carried out by gravitational force. With regard to the latter it is not advisable to use high pressure pumps to force the blue precipitate through the filter press since this does not secure more rapid filtration; the precipitate is very voluminous and it filters

best under a steady moderate pressure such as is obtained by a gravity fall of about forty feet.

It is to be remembered that the recovery of the sodium ferrocyanide is in the first place necessary for the purification of the dyework's effluent, but it may prove an advantage financially where the price of the substance is moderately high.

Attention can now be given to the purification treatment given to the main effluent.

Trials of various methods have shown that the most reliable is that in which the effluent is run for alternate periods in one or other of two large tanks. The effluent in one tank is treated so as to precipitate as much as possible of dyes and chemicals, allowed to settle, and the clear supernatant liquor then allowed to flow forward through the further stages of purification. This tank is then used to collect further effluent while the other tank is being treated in a similar manner. When sufficient precipitate accumulates within a tank it is drained into a sludge "sump" which is used for holding all sludge formed in the purification system.

Precipitation of the dyes and chemicals in the crude effluent is effected in tanks C and D (Fig. 1). Firstly, inorganic salts tend to precipitate most direct, basic, and vat dyes, and precipitation occurs when these dyes mix; but complete precipitation is obtained by the addition of a concentrated solution of alumina ferric (aluminum sulfate) followed by the addition of milk of lime. After the addition of the alumina ferric the whole of the liquor in tank C or D is well stirred up; then sufficient milk of lime is added until a distinct bulky precipitate is formed and which is observed to commence to settle rapidly. This precipitate carries with it most of the dyes present.

After standing for about one or perhaps two hours the precipitate has settled completely to the bottom of the tank leaving a clear supernatant liquor. At this stage, the clarified effluent is allowed to flow through a swivelling arm into a chamber V until the sludge level is reached. The liquor in V is then pumped back into the sedimentation tank E which is the first of the series E, F, G, and H. While passing slowly through these tanks further settling out of any precipitate occurs, so that by the time the liquor emerges from tank H it is almost free from sediment and is practically colorless.

Meanwhile, the sludge remaining in tank C or D is run into the main sludge sump Z, and the tank is again taken into use for further treatment of the crude effluent. This series of operations is repeated continually.

It is found that sediment in tanks E, F, G, and H forms but slowly and at the end of a week or perhaps two it is quite small in amount. Naturally, tank E collects more sludge than does F, and the amount decreases gradually to tank H. From the viewpoint of quantity it would be unnecessary to remove the sludge in these tanks more than perhaps once per month, but it is desirable to effect the removal of sludge from each tank at least once each two weeks. There is definite reason, however, for this frequent removal of the sludge. It will be remembered that an organic sludge of this character must contain various types of mould fungi and bacteria so that it is constantly in a state of decomposition and fermentation. The sludge at the bottom of each tank is not in contact with air (oxygen) and the fermentation which takes place is therefore of the anaerobic type; consequently as a direct result, soluble substances are formed which not only have an objectionable odor but give the effluent a high oxygen-absorptive power which is regarded as objectionable. By removing the sludge frequently, that is, at least once per two weeks, the amount of oxygen-consuming substances formed is considerably reduced or is at least kept within reasonable limits. It is noted that if much sulfur dyeing is being carried out then the sludge obtained from tanks E, F, G, and H frequently has a very objectionable odor.

As previously mentioned the effluent leaving tank H is almost clear and free from suspended matter. Its most objectionable character is that it is deficient in oxygen. That is, if the water is placed with a certain amount of dilute potassium permanganate solution decolorization will ensue rapidly. It is found that fish do not flourish in water deficient in oxygen and rich in oxygen-consuming substances so that the effluent is not satisfactory at this stage for discharge into the stream. The effluent therefore needs areation.

Aeration is effected conveniently by means of the plant shown at J, K, and M in Fig. 1. It consists of two or three large circular tanks (percolators) built above ground level, the walls being latticed so that air can pass into the interior. These tanks are most conveniently built of bricks but these should be of a good quality since under the usual weathering conditions they readily deteriorate and crumble. The effluent passes to distributing arms which rotate over the top of each tank so that the effluent is evenly sprayed over the surface of the coke or broken tiles with which the tank is filled. In this manner the effluent is thoroughly aerated.

The aeration of the effluent is effected while it is falling in small drops through the air onto the surface of the percolators. But it is not merely saturation of the effluent with dissolved oxygen that takes place in this part of the purification plant. Bacterial changes are very important. After a percolator has been in use for a few weeks the tiles or coke become coated with a dark colored slime, and this is really just organic matter saturated with aerobic bacteria. So that as the effluent (saturated with oxygen) trickles downwards over the tiles its dissolved oxygen is activated by the bacteria so that it oxidizes a considerable proportion of the oxygen-consuming impurities present. In this manner the effluent loses much of its objectionable character and becomes the more fit for discharging into the stream.

Aeration of the effluent is also accompanied by a coagulation of colloidal impurities present so that the proportion of suspended solids in the effluent increases. It is because of this fact that the purification plant contains further sedimentation tanks N, O, P, and Q. Th:

(Continued on page 666)

Notes on

Dyeing Blacks

on 100% Woolen Goods

By C. W. NELSON

This article will deal with the production of blacks on the better classes of men's suitings and ladies' dress goods. The subject does not perhaps present to the experienced dyer as many difficulties as some other types of work, but a few practical points may prove of interest.

AFTER-CHROMED BLACKS

MEN'S suitings, which are subject to the most exacting conditions, are almost invariably dyed with after-chromed blacks. Perhaps the most important point of all with men's suitings is to obtain dyeings that do not rub too badly. Good exhaustion of the bath before chroming off is imperative. It is difficult to secure a high degree of fastness to dry rubbing when chroming off takes place in the partially exhausted dyebath, for short of using an excessive quantity of strong acid to clear the bath, complete exhaustion is hardly obtainable on virgin wool. Hence, it is commonly the case that a certain amount of loosely combined dyestuff adheres mechanically to the wool fibers and is only to be removed by a most thorough treatment of the goods in the washing machine with Fuller's Earth.

In cases where liberal amounts of acid have been used in the bath, with a view of good exhaustion, care need be exercised when chroming off. Penetration of thick and heavily milled cloths by the bichromate is difficult in highly acidified liquors, with the result that the cut edges of such materials exhibit a reddish or purplish tinge where the bichromate has failed to "heart" the cloth. In order to obviate this undesirable tendency, the well-dissolved bichromate should be used in several lots, or, alternatively, the bath may be cooled down a little before commencing chroming off and (1) the bichromate used alone, or (2), with the addition of a little ammonia. In the latter case, care should be taken not to make the bath alkaline, or a partial stripping of unchromed color will take place, with deleterious results on the rubbing fastness of the goods.

When dealing with particularly dense cloths, it is sometimes expedient to use about ½% of a blue-green acid dyestuff of high penetrating powers, such as Patent Blue V., in conjunction with the after-chroming black. By so doing, the reddish tinge of unchromed dyestuff in the interior of the cloth is neutralized. Where this practise is adopted, the resulting greenish-toned black may be undesirable and hence, a reddish-toned black need be chosen in the first instance. Alternatively, a suitable addition of a poorly penetrating red dyestuff can be used with the ordinary neutral after-chroming black in order to counteract any unwanted green cast in the surface hue of the goods.

ACID BLACKS

In the case of ladies' cloths, which are subject to less exacting conditions of wear, acid blacks of various types are frequently used. Sulfoncyanine types and naphthalene varieties are generally employed.

The Sulfoncyanine dyes are more expensive than the naphthalenes, but are not so good in leveling when used for salting in acid baths. Also, they are liable to turn dull and dead looking and to lose their characteristic logwood-like bloom on prolonged boiling. This tendency may be counteracted to a great extent by making an addition of ½-1% bichromate to the bath.

The sulfoncyanine blacks yield cleaner dyeings to rubbing than chrome blacks, but do not stand up to wear to the same extent. Moreover, their fastness to finishing processes, like potting and steaming, is inferior to that of the chrome blacks. When compared with the naphthalene blacks, the sulfoncyanine blacks yield bloomier shades of fuller and richer overhand appearance.

It should be noted the sulfoncyanine blacks stain viscose and cotton effect threads rather badly, whereas the naphthalene blacks in this respect are greatly superior and in strongly acid baths, the effect threads remain unsullied.

The sulfoncyanine blacks withstand severe washing and treatment with Fuller's Earth far better than the naphthalene blacks; in many cases the latter undergo a change of tone when severely washed owing to the bleeding of shading dyestuffs that have been incorporated by the color maker. Whereas the use of strong acid and vigorous boiling of the bath are necessary to obtain good value from the naphthalene blacks, it is found that most brands of sulfoncyanine black exhaust sufficiently well in weakly acid baths and by the use of gentle boiling only.

For the correction of unlevel pieces colored with the sulfoncyanine blacks, a treatment in a boiling ammonia

bath is not usually so effective in stripping the color as in the case of naphthalene black dyed goods. Hence to obtain a satisfactory stripping of goods dyed with sulfoncyanine black, the material requires a treatment in an acidified bath at the boil containing about 2% Zinc Formosul.

DYEWORKS EFFLUENT PURIFICATION

(Continued from page 664)

aerated effluent passes through these and is thereby finally clarified ready for its discharge into the stream at R (Fig. 1). The tanks N, O, P, and Q are provided with means for removing the sludge which accumulates in them, and this is pumped up to the sludge sump Z. Sludging of these tanks is carried out regularly and at least once in each two weeks.

The disposal and treatment of the concentrated sludge which is regularly directed into tank sump Z involves more labor than the remainder of the whole purification plant. It has been found that the simplest method of dealing with it consists of adding a suitable amount of lime and then filtering the mixture through the filter presses W. The object of the lime is two-fold: it serves to render the sludge less colloidal so that it can the more easily be filtered, and at the same time it gives to the pressed sludge a certain manurial value so that farmers find it useful for spreading over their fields. Of course, the filtrate from the presses is returned to the main effluent T.

From the foregoing description it will be seen that the main objects of the purification are to free the effluent from suspended and dissolved substances and to reduce its oxygen-absorbing powers to within small limits. At the same time it is further required to make the effluent substantially colorless. It might be considered that a convenient method for reducing the oxygen-absorbing power of the effluent would be that of adding oxidizing substances such as bleaching powder, and it would then also be hoped that any coloring substances present would also be destroyed. Actually it is found that if a reasonable amount of bleaching powder be added to the crude effluent then only a moderate proportion of the oxidizing power of this addition is utilized; it will be found that active chlorine can be detected in the purified effluent. As is well known, fish life is readily destroyed by traces of active chlorine and it is dangerous to the processes of other users of the water to have present such a powerful oxidizing agent. Moreover, the oxidation of an effluent by means of the cheapest chemical oxidant (bleaching powder is about the cheapest oxidant) is very much more expensive than aerial oxidation as brought about by the assistance of bacteria in the percolators.

It is interesting to note that the removal of finishing starches from the effluent is not easy. Apparently none of the precipitants added to the effluent in the initial stages of its purification have any effect on starch and its conversion products such as dextrin and glucose. Yet it is essential that these impurities be removed since they have high oxygen-absorbing powers. The only efficient method for their removal appears to be by bacterial oxidation, for it is found that most of the starch is removed during the flow of the effluent through the percolators.

As previously indicated, the method of treatment of the dyeworks effluent described above, has proved quite satisfactory over a number of years and it might well be copied, perhaps with modifications, by other works which must purify their effluent.

● GENERAL RELEASES

The General Dyestuff Corporation announces the following releases. Copies of the circulars may be obtained upon request.

Fastusol Orange L3RA—a direct dyestuff for which is claimed exceptional fastness to light. It is said to be valuable for self shades as well as combinations either on rayon or cotton. It is also said to be level dyeing, of good dischargeability and does not stain acetate.

Peregal O — a new auxiliary product which, it is claimed, will be of great assistance in overcoming levelling difficulties experienced in vat dyeing, especially in pale shades. It is said that the powerful dispersing effect of this product will have a stabilizing influence on the vat. If the vat should become oxidized, the dyestuff comes out of solution in such a finely dispersed form that upon addition of hydrosulfite a normal vat is easily reproduced. It is further claimed that this product may also be used as a levelling agent for other types of dyes such as basics and in the dyeing of acetate and real silk.

● BRILLIANT AVIROL

An informative book of the above title containing 76 pages of data of interest to the textile industry has just been issued by the Organic Chemicals Department of E. I. du Pont de Nemours & Company, Wilmington, Delaware.

By way of explanation, it is stated that " 'Brilliant Avirol' is the name used to designate the series of alcohol sulfates and other alcohol derivatives which are particularly suited for the softening and finishing of various materials, such as rayon, cotton, silk, wool, paper and leather."

The properties of the several products are described and, in addition, sections of the book are devoted to the processing of cotton and linen, wool, silk and rayon.

Copies of the book are being mailed on request.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

December 3, 1934

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Members should notify the **Secretary** immediately of all address changes

OCTOBER MEETING, NEW YORK SECTION

The October meeting of the New York Section of the American Association of Textile Chemists and Colorists convened in the Chemists' Club, New York City, at eight-fifteen o'clock, October 26, 1934. Ephraim Freedman, Chairman, presiding.

. . . The routine business of the Section was transacted . . .

Chairman Freedman: Gentlemen, this evening we are to be honored by an address from an individual of international reputation.

Dr. Jerome Alexander has created for himself a rather enviable niche in the chemical world. He occupies quite a bit of space in, "Who's Who in America," and I am afraid I would take up too much of your time if I were to attempt to tell you all that this publication has to say about him.

However, I will say that Dr. Jerome Alexander is a member of many technical and scientific organizations, both here and abroad. He is an author of international repute. He is listed in, "American Men of Science," and in the classifications by particular subdivisions of science of one hundred and seventy-five outstanding men, our guest speaker for this evening is listed among them.

His talk this evening will be on, "The Nature of the Combination Between Dye and Fiber." As author of, "Colloid Chemistry," as the translator of Zsigmondy's "Colloids and the Ultramicroscope," and as a man who has devoted his entire life to this most interesting field of chemistry, I feel sure that his talk this evening will be highly interesting and very illuminating.

I take great pleasure in calling upon Dr. Jerome Alexander. (Applause)

Dr. Jerome Alexander: Mr. Chairman, Fellow-Chemists, and Friends: The Chairman's rather flattering introduction puts me somewhat in the position of a certain colored man that limped up on crutches to a friend of his who said, "Why, what is the matter, Rastus? I thought you were the best mule handler in the United States."

He replied, "Yes, boss, that's just what I am. There ain't no doubt about that."

Proceedings of the American Association of Textile Chemists and Colorists

He said, "How come all this mauling? How did you get in this condition?"

"Well," he said, "you see, we-all got in a mule dis mawnin' what never heard of my reputation." (Laughter)

I don't know how I am going to fare this evening. I feel rather as though I am bringing coals to Newcastle in talking about dyes to dyers. Nevertheless, there is some consolation in the thought that the less we know about a subject the more we can talk about it.

Nature of the Combination Between Dye and Fiber*

By JEROME ALEXANDER

IT isn't my desire to be in any way exhaustive in discussing this question of the nature of the combination between fiber and dye because to be exhaustive is usually to be exhausting, both to yourself and to the audience. So I would like to consider mainly certain principles that are involved. These principles are very far-reaching.

St. Paul remarked that we cannot be "all things to all men", but a theory has to try to be all things to all experimental facts. It must do that or else it isn't worth much. Consequently you must be willing to allow theory a little bit of latitude in presentation.

I did want to rig up a little gallows here and hang up some favorite bête noire, but I couldn't do it. So I brought along this rope. As you see, I had to tie the two pieces of the rope together. I wanted to show you that by making this knot in the rope I did make a very substantial combination between these two cut pieces of rope, and they hold together remarkably well. I don't think you would call that a chemical combination, but it holds. I think this little cord would strangle any one of us.

However, if you take this rope and look at it a little bit more closely, by unraveling the ends of it, you will see that it is made up of a large number of subsidiary or smaller cords which have been twisted together. This particular rope has seven of them. There they are. (Illustrating.)

If we were to look a little bit closer into these subsidiary cords we would see a large number of cotton fibers in each one of them, and that is probably as far as our unaided eye will take us.

My object, as you perhaps will begin to fathom, is to bring to your attention that there are successive degrees of size in the grouping together of matter. I have taken these things that are visible to the unaided eye because that is an easy way to begin. But I want now for you to bear with me while we go a little bit further below what the eye can see and consider the structure of a fiber, because before we consider the combination between a fiber and a dye we certainly ought to know something about how these fibers are built up and also something about how they are going to behave under the conditions of operation.

Microscopically, a cotton fiber is known to you all. You know its lumen, protoplasmic residues, its characteristic twists, and so on. A great deal of work has been done on that which it is hardly necessary for me to rehearse here. A silk fiber looks very much more homogeneous under the microscope. Wool fiber has its own serrated peculiarities, and so have all other fibers. The point I wish to make is that all of these fibers, even the silk fiber, which looks simple, can be demonstrated by other means to be very, very complex. We know it is complex chemically, but the mere analysis of a fiber doesn't tell you how its molecules are built up to form a structure that you can see even under the microscope. The molecules, themselves, are exceedingly small. However, owing to the development of the X-ray spectrometer it is possible to get information as to the structure and shape of the molecules themselves; also how the molecules are built up to form molecular groupings, called by the X-ray spectrometrist, *unit cells,* (that has nothing to do by the way, with Communism and strikes) how these unit cells are grouped together into larger combinations, and how these larger combinations then group up finally to form a fiber. So the fiber itself must be considered as a very complex unit, with many subordinate structures in it.

Fibers vary greatly in size, most of them being of visible dimensions, measurable in millimeters. Relatively speaking, fibers themselves are large. Molecules are of the order of *micro-microns,* which are *millionths* of a

*Presented at Meeting, New York Section, Oct. 26, 1934.

millimeter; the molecules in fibers are of the order of one millionth of a millimeter in length, but much less in diameter. These elongated molecules are arranged in chains and the chains are in bundles, and the bundles group up to make a fiber unit.

You can easily understand that there is a great difference in the ability of particles of different sizes to get within the relatively *larger* interstices of the fiber complex, and the ability of the same particles to get within the *finer* interstices. Particles of dyes, when in solution also vary very considerably in degree of dispersion, in size and in shape. Dye molecules themselves vary in size. In the *practical dye bath,* dye molecules are very often aggregated into groups, the general rule being that at higher temperatures the groups are smaller. There are various means employed by practical dyers to make the molecular groups either larger or smaller. These will be referred to later on.

The hydrogen molecule has enormous kinetic activity; its speed is a mile a second, more or less. On the other hand, particles which are so big that they can settle out, have very slight motion in the liquid in which they are suspended. If small enough they show the so-called Brownian motion first observed by a Scotch botanist, Robert Brown, in about 1827. Brown saw within pollen grains little particles keeping up a very rapid dance. He then found out that quite a number of other things, like coal dust and non-living very small particles of various kinds, about the limit of visibility in an ordinary microscope, would also exhibit this uneasy oscillation around their mean or average position. This motion was named after him, the Brownian motion.

About 1903, a professor at Goettingen University, Professor Zsigmondy, who was working with colloidal gold, which he had independently discovered, conceived the idea of passing a beam of sunlight focused with a lens, *across* the optical axis of a microscope, and then looking into the solution thus illuminated by that beam of light. He saw particles smaller than had been seen before.

The principle is a simple one. Ordinarily, the light is reflected up through the optical axis of the microscope from a mirror. It passes *through* the object you are examining, to your eye. Since you are looking *against* a *bright* background, the light coming directly into your eye dulls its sensitivity. Zsigmondy, however, looked against a *dark* background at a beam of light shot substantially at right angles to his field of vision. This room is full of dust particles, but we don't see them, because there is too much diffuse illumination. However, if we were to darken the room completely, and then allow a beam of sunlight to fall at right angles to our line of vision, we would see these motes or dust particles floating in the beam. On the same principle the small stars are not visible on a bright moonlight night. They are there, but you don't see them because of the superior luminosity of the moon. On a black, dark night the feeble stars shine out.

The particles that Zsigmondy could see with this instrument, which he called the ultra-microscope (because it permits us to see beyond the microscope) are *visible* but they are *not resolvable*. There is a difference between these two terms, which is not commonly appreciated. You can *see* the fixed stars. You can *resolve* the round disc of the moon with your naked eye. You can even resolve the phases of Venus with a good field glass or a small telescope. But even a most powerful telescope never can make anything else but a *point* of light of the fixed stars. They are *visible* but *not resolvable*. That is the exact analogy to what we have in the ultra-microscope. The particles are smaller than the wave-lengths of light. How can you, therefore, hope to resolve them? You can see them, but since in order to *resolve* a thing you must have light coming from the various sides of it, if the object is smaller than the wave-length of light, you can't possibly effect resolution.

So our ultra-microns, as they are called, are visible, but not resolvable. Recently I read a paper where the author spoke of seeing ultra-microns as spheres. All he saw were diffraction discs.

If ultra-microns are elongated you may use what is called the azimuth device on the ultra-microscope. If, when you illuminate the field from one direction, and the particles appear very bright, whereas if when you illuminate at right angles the particles appear less bright, this is evidence that the particles are elongated rather than spherical. This observation can be made only if you can get the particles to be oriented in one position. It is sometimes done by stirring to make them flow, head-on, like logs in a stream or else by magnetic or electrical influence.

Later on I am going to show you the individual particles of Benzopurpurine 4B in this solution of the dye. They move very rapidly in the ultra-microscope, showing an exaggeration of the Brownian motion, which has been proven by Albert Einstein, Jean Perrin and others to be *a visual demonstration of the kinetic theory.* In other words, the smaller these particles get, the more and more rapid becomes their motion, until when you get down to molecular dimensions the motion becomes terrific.

You can easily see that as soon as you begin to get your dye dispersed too far, you may reach a point where the kinetic velocity of the particle becomes very important. To show you how important it can be, let me relate to you an experience I had at a meeting of the British Association for the Advancement of Science at Toronto in 1925.

Sir Ernest Rutherford, who is the man that developed our present knowledge of the structure of the nuclear-

atom, was there, and he was talking about the effects he had gotten when positively charged alpha particles shot out by radium happened to make a direct hit on the positive nucleus of an atom. The alpha particle is deflected, and in the photographs taken of this phenomenon in the Wilson fog chamber, you can actually see the deflection as a nick in the line of flight of the alpha particle.

To illustrate that principle, Sir Ernest had a magnet fixed to the table with its positive pole up, and hanging from the ceiling, from a socket above, he had another magnet with a positive pole down.

"Now," said Sir Ernest, "you see if I swing this positive pole near the fixed one, it will be repelled". He swung it nearby and of course the two positive poles repelled each other.

"Now," he said, "if I register a direct hit, you will see that the fixed positive pole on the table will cause the other to bounce back." So Sir Ernest took very careful aim, and he was a good shot, and he registered a direct hit. But the swinging magnet didn't bounce back; it continued right on over past the fixed magnet, probably making a little jump upwards as it did, which we couldn't see.

What happened? In that swing, he had *exceeded a certain critical velocity* beyond which the repulsive force of the two magnets was ineffective. He quickly retrieved the swinging magnet and swing it from a closed distance towards the fixed magnet, and that time it bounced back.

That was a lesson to me and to that incident in the demonstration I applied the following reasoning: Suppose that we had the positive pole of the fixed magnet on the table pointing up, just as we had at first. But suppose we had the *negative* pole of the swinging magnet turned down. Now, if we swing the negative pole near the positive pole, the positive pole and the negative pole should hold each other. *But they won't hold if the velocity is too great.* You see, there is a critical velocity. If you exceed that velocity the attractive forces are not going to be able to hold the two attracting poles together.

So we have to consider the question of particle size and velocity in our dyeing operation. For the moment, I am not considering precisely whether you are going to call the attractive forces between fiber and dye chemical or physical. We will talk about that later. After all, it is a matter of language. I would rather fix your attention first on the physical facts.

Consequently, it seems quite obvious that one of the important factors in physical or chemical reactions between particles or magnets, or anything else, is their velocity relative to each other. It is conceivable that particles or magnets will have such great velocity that despite their attractive forces, they won't stick together.

You dyers will probably be able to tell me more than I can tell you about the many devices which you use practically to bring your dye particles to what I might term an *optimum dispersion,* so that they will not go in and out of the fiber, but will be able to get in, to stay in and not to tear away. Temperature is one factor, but the action of salts and acids is another. To prevent too great aggregation, you often add what we call dispersing or protective colloidal substances, like boiled off silk liquor.

Everything depends, naturally, upon the specific qualities and properties of the dye. Some dyes need aggregation in order to get them big enough to stay put. Others may need dispersion in order to get them fine enough to go on.

I am trying to put this into your minds: that if you want a substance to dye a fiber, you first have to get it *up to the fiber,* you have to get it *into the fiber,* and you have to *make it stay there.* All of three things are involved. If the particles of dye are just simply undispersed dust and you blow them on the fiber, you can blow or wash them off again. If you get them too fine or too active, it is possible that they won't stay in the fiber. Getting dye on is really something like "Hop, skip, and jump." The hop is to get it up to the fiber; the skip to get it within the fiber; and the jump is to get the dye and fiber to stay together and then stop. Usually, when you take the fiber out of the dye bath, the dye "stays put". That is, you hope so.

Now comes the question of how we are going to consider this combination of the fiber with the dye. Is it chemical or physical? That is the question people generally ask. My answer is, It doesn't make any difference. It is all a question of what particular weight or meaning you are going to give to the words "chemical" and "physical."

We now know that all matter seems to be made up primarily of electrons and protons, that is, negative electric charges and positive electric charges.

Physicists also recognize neutrons, positrons and photons, though their places in atomic structure and atomic action are not yet entirely settled.

The electron has been weighed by Milliken, who had little tiny oil droplets which he stuck full of electrons, like you would stick currants in a bun. He had as many as 150 or more electrons stuck into a single colloidal oil drop, and he weighed each one, showing that the particles of electricity were all of like weight; in other words, electricity is a definite substance, whose unitary particles are of like nature and weight.

All matter is composed of uniform electrical particles. When they group together in certain very definite configurations to make what we know as our chemical elements, there remains some residual electronic aura, some electronic ectoplasm about the atoms, more about some than others. For instance, the rare gases, like nitrogen, argon, helium, xenon, and so on, have very slight at-

traction for anything even their own kind. They are so-called inert gases, but they have *some* residual attraction. Otherwise, it would be utterly impossible to liquefy them. However, most of our elements are quite capable of combining by means of their residual electronic yearnings or attractive valencies. But even when atoms form molecules, those molecules still have some residual electronic attraction, and they form groups of some kind, and these groups combine to form larger masses, and so on, until we finally build up particles that we can see in the microscope.

If you observe, I am trying to make you think of what I have termed the sub-microscopic structure of matter. There is a complicated structure below what you see with your eyes. As a consequence, we are confronted with this question: *where* are we going to draw the line of demarcation between chemical and physical compounds?

I am a chemist and loyal to chemistry. Nevertheless, I wonder whether in a broad sense it isn't fair to consider chemistry simply as a certain specific zone in what has now become the much broader field of physics. I don't mean physics in the old sense, when we discussed levers and the parallelogram of forces. But I am thinking of physics in the broad meaning of the term, which includes the study of matter as a whole.

You see, we have developed, especially within the last fifty years a whole school of physicists whose work has been in sub-atomic phenomena. In fact, if you will look at our Chemical Abstracts, you will see that we have a special section devoted to sub-atomic phenomena, so important are they to chemists.

Just where in each case you are going to draw the line of demarcation between groups or configurations which you are willing to consider as definite chemical combinations, and other groups or configurations which may be strong, but not so precise in proportions as the orthodox chemical compounds, I don't know. I must confess that it is a very difficult thing to do. I doubt whether it can be done and, personally, I see no object in doing it. As I said before, it all depends upon the limitations you set on the terms "chemical" and "physical".

Phenomena occur in nature. We use language very often, as Talleyrand once said, to conceal thought. Concentrate your minds upon the physical happenings. I say this despite the idea advanced by many of our modern physicists that you mustn't try to form a mechanical picture of what is going on. I think that we must try to make a mechanical picture wherever it is possible, instead of relying blindly upon a mathematical formula.

I don't want to go to any extent into the question of the various theories of dyeing and give you a historical resumé. I think that would be very boring. You have read all the different points of view. Some people maintain the chemical view, others maintain the physical view, the adsorption view; Harrison maintains the electrical view, and Otto Witte, in 1890, advanced the solid solution view.

It doesn't make any difference what terms you apply to the facts. There is one very important thing, however, that I trust you won't forget; you must have the material that is going to dye your fiber so finely dispersed *that it can get in*. Of course, it has to be brought up to the fiber. Once it is brought up to the fiber, which is aided by mechanical circulation and by thermal agitation, the particles have to be *small enough and have sufficient kinetic activity to get in*. There is nobody there with a shoe-horn to ease them in. They have to worm their own way in. Once they get in, then the question of the specific chemical nature of the dye and of the fiber is a matter of the highest importance. Once within that complex structure of the fiber, the dye particles must be held fast by something. What is the something?

There may be cases where very specific, definite chemical compounds are formed. It is quite possible that in those cases dyeing will be understandable on the basis of a definite chemical reaction. On the other hand, imagine this whole table to be the fiber. Suppose that it has a number of different *specific electronic areas* on it. These areas constitute what I may call the electronic physiognomy of the fiber, the physical contour map. The dye must hold fast to these specific areas. Different dyes may be fixed to different areas of the same fiber, depending on mutual attractions.

We have a similar situation, for example, in the relations that are found in biology between what they call the poison or *antigen* and the so-called *antibody* specific to that antigen. If you inject an animal with a poison like diphtheria toxin, in that animal's blood an antibody develops which is highly specific, apparently with oppositely charged electronic areas, so that it will exactly neutralize diphtheria toxin, but no other toxin.

In this very ultramicroscope I have observed that on mixing diphtheria toxin and diphtheria antitoxin, the two combined to make an insoluble "precipitate". I could see the colloidal coagulation take place under my eyes. But when I took tetanus toxin and mixed diphtheria antitoxin with that, there was no action. And when I took diphtheria toxin and mixed tetanus antitoxin with that, there was no action. But when I took tetanus toxin and mixed tetanus antitoxin with that, I had the same coagulation.

The point I am getting at is that there is a specificity between the toxins and the antitoxins which enables them to combine. I don't mean to say that the specificity has to be *absolute*, but it has to be *sufficient*. As a consequence, there are many of the antibodies which will combine with a number of different antigens or toxins which are similar. I suppose it is the same way with dyes. To

hold successfully, the dye must find a suitable specific area in the fiber.

I brought along this specimen of asbestos rock because I wanted you to see that there is something also in the way the fibers themselves are opened up. It wouldn't be very easy to dye this piece of rock, but if you rub it up mechanically you get very silky fibers which you can spin into a thread which might be dyed because so much surface is exposed. Opening up the interstices between the fibers would enable dyes to go in that otherwise couldn't. Probably you would have to fix a mordant on first, and then fasten the dye to the mordant.

So we get down to this point: that if you want to dye anything you have to get the thing you are going to dye sufficiently opened up (or it must be so naturally) for the particles of dye to get into it, and then be fixed upon it by specific attractions which come nearer and nearer, if I may say so, to chemical forces, the finer the particles are and the more specific they are to the surface of the fiber.

If you were to spill a little nitric acid on your coat or on your finger, I wouldn't want to say that we had made "nitrate of chemist," although we might perhaps spell out a definite chemical combination between some portion of your skin and the nitric acid. In the same way, if you were to stick particles of dye on various portions of the fiber so that the dye looked homogeneous, I don't know that it would be fair to say that you had definite chemical combination. It may be so in some cases. On the other hand, it is quite possible that it isn't so. But, in any event, the attractions are of the same electronic nature as one finds in chemical attraction, though they may be much more feeble. Bleeding and crocking are not unknown phenomena.

Mr. Zisman kindly prepared a few samples for me and before I rig up this ultramicroscope I will tell you about them. He dyed these specimens with the same dye in different solutions so prepared as to alter the dispersion of the dye very materially. Different shades came out.

We will now make a demonstration for you with Benzopurpurine. If we take some of this dye and add some hydrochloric acid to it (demonstrating), the dye acid is set free. The solution turns blue and the dye acid will settle out. I will give it time.

Now I want to show you a little trick in connection with this color change. I will put a little gum arabic into the same dye solution, *before* I put in the acid. If we put our hydrochloric acid in we know the dye acid is going to be liberated in the same way. But as you see, it does *not* turn blue, as did the dye without the gum.

I examined these color changes in the ultramicroscope and reported on that in a paper published in the Journal of the Society of Chemical Industry in 1911. In the original solution you see the ultramicrons moving actively about, as you will observe later. In the blue precipitate the ultramicrons are gathered together in large masses and clumps like bunches of grapes. Their kinetic activity has ceased, so that they sink to the bottom and precipitate out. In the glass containing the colloidal gum, although the hydrochloric acid set free the dye acid, the protective action of the gum arabic prevented the particles from getting together. The dye acid ultramicrons remain dispersed for the most part, and consequently the solution does not turn blue, or settle out.

Although there may be a slight amount of aggregation, the particles will not be sufficiently aggregated to settle out. So you see the use of a protective colloid in a dyebath may prevent dye particles from getting into a hopeless stage of aggregation.

I will now put the gum aragic in both of these reacting solutions, both in the acid water and in the dye. You will observe that the color change is less marked than in the experiment where I added the protective gum to only *one* of the reacting solutions.

I think you can see here an analogy with what is accomplished by boiled-off liquor, which tends to prevent the dyestuff from becoming too highly aggregated.

Of course, it is quite well-known that *temperature* affects the dispersion of the dye. That is one reason why you use hot dyebaths. Temperature also makes for more kinetic activity, and it also affects the fiber. You must be broad enough to see that you can't concentrate your mental microscope on only *one* aspect. Many things take place simultaneously and they all figure in the net result. The fiber is affected. The kinetic activity of the dye is affected; the size of the dye particles—all of these things are affected by temperature, by acids, by salts, and by incidental protective substances in the bath.

In 1923 I discussed "The Degree of Dispersion as an Influence in Tanning," before the American Leather Chemists Association.

This critical or optimum degree of fineness approximates what I term the "zone of maximum colloidality." Colloids are intermediate between suspensions which settle out, and true molecular solutions of small molecules, where the dispersed particles move about madly.

Therefore you can get into the colloidal state in one of two ways: either *by aggregating* small molecules *until* you have molecular aggregates that are *big enough*, or *by dispersing* large pieces or hunks, *until* you get particles that are *small enough*. Somewhere in between, there is a degree of dispersion where you get an optimum effect.

That very thing happens, for example, in the manufacture of rayon. The solutions of viscose are aged until they are *ripe*. What is the meaning of that word "ripe"? They simply wait until they reach the optimum degree of ageing, for spinning. If you age the viscose solution be-

(*Skip four pages*)

Proceedings of the American Association of Textile Chemists and Colorists

FOURTEENTH

ANNUAL MEETING AND CONVENTION

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

December 7 and 8, 1934

HOTEL NEW YORKER
NEW YORK CITY

UNDER AUSPICES OF NEW YORK SECTION

ANNUAL MEETI

PROGRAM

FRIDAY, DECEMBER 7

1:30 P.M.—Ninety-eighth Council Meeting.

2:30 P.M.—Ninety-first Research Committee Meeting.

6:00 P.M.—Buffet Supper in the Ballroom followed by Music and Entertainment.

7:45 P.M.—OFFICIAL OPENING OF THE CONVENTION.

Rayon Symposium.

Speakers:

J. F. X. HAROLD, *Consulting Chemist*
H. D. W. SMITH, *A. M. Tenney Associates*
E. H. BENZING, *American Bemberg Corp.*
J. B. QUIG, *Du Pont Rayon Corp.*

9:00 P.M.—The Commercial Extraction of Bromine from Sea Water.

LEROY C. STEWART, *Dow Chemical Co.*

(*Illustrated with lantern slides and with the motion picture,* "THE MAGIC KEY")

10:00 P.M.—Entertainment.

SATURDAY, DECEMBER 8

9:30 A.M.—Absorption of Moisture by Aeronautical Textiles

G. M. KLINE, *U. S. Bureau of Standards*

9:45 A.M.—Fading of Dyeings in Radiation of Different Intensities

W. D. APPEL, *U. S. Bureau of Standards*

10:05 A.M.—Various Applications of Fluorescence Analysis

A. E. SAMPSON, *Calco Chemical Co.*

10:30 A.M.—Some Applications of Sodium Metaphosphate to Textile Processes

C. T. MUNTER, *Hall Laboratories*
E. B. BELL, *Calgon, Inc.*

10:55 A.M.—Selling

A. R. THOMPSON, JR., *Ciba Company, Inc.*

11:10 A.M.—The Progress of Textile Research in the South

CHARLES B. ORDWAY, *Alabama Polytechnic Institute*

11:30 A.M.—The New Textile Technology

E. R. SCHWARZ, *Mass. Institute of Technology.*

12:00 A.M.—BUSINESS MEETING:

Annual Reports of Officers and of Committee Chairmen: Election of Officers and other Business.

• Recess for Luncheon •

2:00 P.M.—Quantitative Analysis of Fiber Mixtures

R. T. MEASE, *U. S. Bureau of Standards*

2:20 P.M.—The Mechanism of Dyeing—Part II

ROBERT E. ROSE, *E. I. du Pont de Nemours & Co.*

2:50 P.M.—Inconel, An Alloy for Textile Wet Processing Equipment

F. L. LAQUE, *International Nickel Co.*

3:10 P.M.—Recent Developments in Tensile Testing Machines

DAVID SCOTT, *Henry L. Scott Co.*

3:30 P.M.—Short Recess.

3:40 P.M.—Effect of Alkalies on Wool

MILTON HARRIS, *Research Associate of the A.A.T.C.C. at the U. S. Bureau of Standards*

4:05 P.M.—Bleaching with Chlorine

W. L. SAVELL, *Mathieson Alkali Works*

4:30 P.M.—Some New Applications of Surface Chemistry to Textile Processes

H. A. NEVILLE, *Lehigh University*

5:00 P.M.—Aluminum Chloride Carbonizing

B. A. RYBERG, *Research Associate of the A.A.T.C.C. at Lowell Textile Institute*

7:00 P.M.—BANQUET

Toastmaster: P. J. WOOD
Speakers: A nationally known figure.
A humorist.
An economist.
Our Association President: R. E. ROSE
Chairman of Research Committee, L. A. OLNEY

Entertainment.

DECEMBER 7 AND 8

A

NEW YORK CITY

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largest and tallest of New York's sky-scraper hotels, where the American Association of Textile Chemists and Colorists begins its convention Dec. 7th. The New Yorker is forty-three stories tall and has five floor levels underground. With 2,500 guest rooms, the New Yorker is so large that a convention, even a large one, creates hardly a ripple in the smooth flowing course of its operation. Its accommodations range all the way from very moderately priced single rooms to very luxurious suites. The Grand Ballroom and the North Ballroom, both of which will be used by the Association on various occasions during the convention, are on the second floor, on the north and east sides of the building. The New Yorker has four restaurants, including the Manhattan Room, one of New York's most famous cocktail rooms, and the Terrace Restaurant, where Ozzie Nelson and his orchestra play nightly for dancing until 3 a.m.

AND CONVENTION

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yond that point, then the entire voyage of your spinning is "bound in shallows and in miseries."

DISCUSSION

Dr. Alexander: I think probably I have said enough. I want to thank you very much for giving me your attention. I hope that you haven't found the general outline I have given you too dry.

By the way, if you wish now, I will rig up this ultramicroscope and put some of this Benzopurpurine solution under it and then you will have to look in it one at a time.

Chairman Freedman: Are there any questions that any of you would like to ask while Dr. Alexander is preparing his slides?

Mr. Baumann: Dr. Alexander, you mentioned the word "adsorption." Would you please explain what is meant by "adsorption" against let's say, "absorption" or some other word that we might understand?

Dr. Alexander: Of course, like all words, these words have suffered some changes in meaning, from time to time. But very generally, adsorption means the concentration of material at a surface. Absorption means its entering within the volume of the adsorbent. For example, water is absorbed by a sponge, but very hard carbon might adsorb a gas, or dye, even if the dye didn't penetrate further than the surface. The whole idea of absorption originally was the taking up within the mass of the thing, whereas adsorption is bringing it "ad," or up to the surface.

Mr. Bell: Dr. Alexander, that question brings up another question: In adsorption of a gas, which you mentioned, quite often, I understand, there is concentration at the surface which is very high and in a gas, a very high concentration usually means a very high pressure. Could you elucidate that a little for us?

Dr. Alexander: Yes; of course, when you come to specific phenomena, you have to consider the specific facts. For example, in many specimens of carbon, where there is a very intense amount of adsorption or absorption, the two phenomena get mixed up, owing to the fact that the substance which is doing the adsorbing or absorbing has an interior structure, and in many cases, the adsorbed material works its way into these very fine capillary-like structural units, where what I may call the specific electronic forces are terrific.

You know, of course, that diamond is one of the hardest known substances, and you can imagine that the force holding carbon atoms together is very great. If the atoms are separated very slightly, so that some other substances could get in between them, you can imagine the attractive forces might hold that substance very tenaciously. Even if the carbon is very finely divided, its free surface may have that same specific attractive action. Where you get substances in a very fine state of subdivision, the surface per unit weight goes up tremendously. A single cubic inch of material could be easily made to have an acre of free outside, rind, or skin surface to it, if you reduce it fine enough.

If you throw up some water against a window pane, a certain amount of water will stick to the glass. Suppose you grind that glass up to a very fine powder, thereby magnifying the surface of the glass, say, ten thousand times. That very finely powdered glass would hold moisture very much more tenaciously.

Mr. Drew: Doesn't the fact that you can dye a piece of cloth uniformly signify a certain chemical attraction for the dye? In other words, wouldn't there be a piling up on one part of the cloth and a lack of dye in another part of the cloth if that weren't so?

Dr. Alexander: My first reaction to that would be this: How do you know that the fiber is dyed uniformly? What you mean is that it looks uniform to your eye, that is all. It might be possible in many cases to demonstrate that it isn't, and you have got to go down through the successive layers of the structure of matter until you come to the lack of uniformity.

I will give you a very practical illustration of what I mean by that. In these very experiments of Millikan, who received the Nobel prize for his wonderful work, he made use originally of the formula of Stokes, a very general formula which deals with the resistance offered a body falling through a homogeneous medium. I won't go into the nature of the formula, but it had been found satisfactory. However, Millikan discovered that in the particular case he was dealing with, his colloidal oil droplets were so extremely small that they fell between the holes in the air. In other words, they fell in between the molecules of the air.

This was something that wasn't figured in Stokes' equation which assumes a *homogeneous* medium. But to colloidal particles as fine as Millikan's oil droplets, the air wasn't homogeneous any more, and Millikan had to work out a correction for Stokes' formula, treating the air as a non-homogeneous medium. When you get down to small enough areas in your fiber, it isn't homogeneous. You know it isn't. An atom isn't homogeneous. A molecule isn't homogeneous. I suppose the areas that accept the dye correspond to the Jabberwock's "claws that catch," if you know the jingle from Lewis Carroll's tale.

So, in all probability, certain areas of a certain section of the fiber may grab some dyes, and certain other electronic areas may grab another kind of dye. I don't think, personally, that the dye has to be fixed in precisely the same portion of the fiber at any time. It depends on the dye. It depends upon the fiber. It depends upon the conditions. But you, as a dyer, would probably say in all cases that the thing is dyed homogeneously. Beware of that word "homogeneous." I may say that you can't

even imagine anything that is homogeneous, much less find it in nature. Nothing that we know in nature is homogeneous. It may appear so, but things are seldom what they seem, as Little Buttercup remarked.

Mr. Bren: Dr. Alexander, I know it isn't fair to ask questions of isolated cases in phenomena, but one thing that has puzzled me always has been why Para Red put on wood will travel right through the wood.

Dr. Alexander: How is it put on?

Mr. Bren: All you have to do is put on a solution, and in time it will travel right through the wood. I don't know of any other dye that will do that. It will penetrate, I understand, through about two inches of even a hard wood.

Is that due to the particle size? Could you say that that was a phenomenon something like the velocity of hydrogen—it is so small that its forces are so great, and it gets through there?

Dr. Alexander: Tell me first what you mean by Para Red. I mean, define it. Do you mean the one made with beta-naphthol?

Mr. Bren: Yes.

Dr. Alexander: How is that put on the wood? Give me the particulars of the case.

Mr. Bren: I think it was just an ordinary solution of acetic ether, but it was a very concentrated solution.

Dr. Alexander: The final color was in that?

Mr. Bren: Yes. It was just dissolved.

Dr. Alexander: That is, you first made the developed color. Ordinarily, those colors are developed on the fiber. But this wasn't developed on the wood?

Mr. Bren: No.

Dr. Alexander: You took the Para Red, such as Para Toner, for example, and dissolved the concentrated Para Toner in acetic ether?

Mr. Bren: Yes.

Dr. Alexander: What kind of a solution was that? What did the solution look like, do you know?

Mr. Bren: About an intense flame color, yellow sodium.

Dr. Alexander: Does it go in true solution, complete atomic dispersion there. Do you know?

Mr. Bren: I couldn't say.

Dr. Alexander: Of course, if the substance is in true solution, it might penetrate very far. You know, just as the Constitution follows the flag, so the solute tends to follow the solvent.

Mr. Bren: But the fact is I tried to explain that on the theory, "Well, now, the solvent there probably had something to do with it," but you can't explain it that way. You could put all the acetic ether you wanted to on that wood. Perhaps it would evaporate, but I can imagine you could have such a chamber, where you would have it saturated above the wood, and still that acetic ether would never go through that wood.

Yet this color goes through, and if you haven't experienced it, it is a good phenomenon to try.

Dr. Alexander: Well, yes, I would actually like to see the experiment, because one would learn a great deal from observing precisely what happens. I judge from what you say that when you put this solution of acetic ether on the wood, the acetic ether would very readily penetrate the wood. You might not see a great deal of it go in, but I imagine it will, and the solute will tend to follow it.

To show you how solutes follow the solvent, if you take a block of a plaster of Paris and dip it in sulfate of copper, you can prove that the sulfate of copper has completely permeated the block by breaking the block in half, and you will see that it is blue clear through.

If you take a similar block, soak it in sulfate of copper and put it on the radiator and let it dry, as the water diffuses to the outside of the block to evaporate at the exposed surfaces, it takes with it practically all of the copper on the interior of that block. Most of the copper is right up close to the surface where the evaporating water has left it.

The converse might be true in your case: This solvent working into the wood drags with it a great deal of your dye, but in this particular case, in all probability, the dye is seized upon by the wood. In other words, once it is in, the wood may take hold of it, and the wood would be apparently dyed.

We have another very common illustration of this principle. You know one of the tricks in taking out grease spots from clothing is not to put your carbon tetrachloride or gasoline *on* the grease spot, because as soon as you do that, immediately by diffusion, the fabric pulls the solvent with the dissolved fat outward, and when it evaporates you have a lovely "ring." You get much better results if you start on the outside, make a ring of solvent and start your solvent diffusing inward, having a piece of blotting paper underneath where the grease spot is. Then, the solvent rushes in towards the grease spot—the whole diffusive mobility is inward. As soon as the solvent reaches the grease spot, then quickly pour enough solvent on to wash the grease spot right through into the blotter.

Mr. Bren: The point is, you can take dyes that are more soluble than acetic ether and they will not do that. It seems to be specific to this particular thing.

Dr. Alexander: I can easily understand that. Of course, all I can give you, without actually having observed the particular case, are principles.

I will show you how that also might not be. If the dye, having first gone into the wood, immediately begins to combine with the wood and block the interstices of the wood, you may stop penetration entirely and the dye will stay on the outside.

I will give you another practical illustration: I was

attending a meeting of the American Association for the Advancement of Science in Philadelphia, and I noticed the bacteriologists were going to hold a big symposium on ultrafiltration. I was very much interested in ultrafiltration and I went over. I sat way back and kept my ears open, because you know, like other jackasses, I have two long ears, and I can listen as well as bray. (Laughter.)

I was listening to what they were saying about ultrafiltration as a means of determining the size of bacteria. One of the propositions they brought up was this: that if you have a hole of a certain size, and the bacterium goes through that hole, obviously, the bacterium can't be any bigger than the hole. That was one proposition.

The other proposition was, if you have a hole that is larger than the bacterium, there isn't any question but what the bacterium is going to go through that big hole.

Both propositions are not inevitably true at all. It can be easily demonstrated that you can make, if I may say, a bacterial camel go through the eye of a needle, and the trick is this: in ultrafiltration you have pressure, and this pressure may force the small particle, *as a thread,* through a much smaller hole than itself, and when it gets through the hole, it may round out again and become a great big camel. That is precisely the way in which our white blood corpuscles get through the capillary walls. They ooze through as a little fiber or thread. When they get outside, they round out again.

The other proposition, which has a bearing on your case, is this: If we have a hole, say an inch and a half in diameter, it is quite obvious, of course, that particles the size of a penny or a dime should easily go through. It is also wrong; they may go through in many cases, I don't doubt it, but I will show you a case where they won't go through.

Suppose that these particles, by any kind of attraction—call it chemical, physical, adsorption—stick on the side of the hole. Of course, the "holes" in these filters are really little capillary tubes. Now the particles begin to stick and quickly clog up the tube. Nothing may go through at all.

In certain cases depending upon the wood, the solvent and the color, the dye may penetrate a little, but being quickly and rapidly fixed in the capillary spaces of the wood, may utterly prevent the passage of further dye particles in them.

For another case, let's take the work that Zsigmondy and Schultz did on colloidal gold, which I referred you to at the time in Philadelphia. They found that if you started to ultrafilter through Berkfeld filters, or Pukal or Masson filters, the gold would begin to go through for a short time, and all of a sudden it would stop. But if you mixed with that colloidal gold a little white of egg, then you could keep right on filtering it through. Why? What happened was this: The egg albumin was first fastened, adsorbed or chemically combined at the surface or the pores of the filter, and being fixed there, those tiny albumin molecules *prevented the gold from being adsorbed.* So the gold kept on going through. So whether you got the gold through or not depended upon whether or not you had in the gold a protective colloidal substance which was preferentially adsorbed by the interstices.

You see the principles are simple. But what happens in a particular case depends upon the particular conditions. All I can do is to give you the principles and if you want to find out what happens in a particular case you must study that particular case.

Chairman Freedman: Are there any further questions? Dr. Harold, would you like to add to the discussion?

Dr. Jos. F. X. Harold: I don't know that I can, except to follow the last question up a little and say that sometimes what we call dyeing is not the dyeing of the material, but a transference of the dye solution as such into the particle of the material, and that a product of the solvent, plus the materials encountered in the wood, may form a composite solvent that will make the dye travel, whereas the ordinary solvent itself cannot travel.

In other words, we may be dealing there with a case of the solvent being modified by the constituents of the wood, be it the resins, the tannins or whatnot, that add to the adsorption by the wood. The questioner said distinctly that the solvent didn't travel, but that the solvent imbued with the dyestuff did travel. So we may, therefore, have a case of the dyestuff, the wood constituents, and the solvent itself, making a new complex of an entirely different solubility.

In these insoluble dyes of the Para Red type and of oil soluble colors, we frequently have dyeing that has nothing to do with the color or the material at all. But the solvent itself is dyed. In the dyeing, for example, of bone and ivory, by dyestuffs dissolved in stearic acid of the basic dye type, you can take a "U" tube filled with powdered bone dust, or powdered ivory, and you can put down upon one arm of that "U" tube a basic dye dissolved in benzol with stearic acid. The dye will travel down the "U" tube and through the bed of powdered ivory or powdered bone, and come up the other arm of the "U" tube in absolutely the same concentration it went down, proving that there is no specific absorption of the dye by the bone dust or the powdered ivory, and that the dyeing of the ivory and the bone is due to the dyeing of the solvent and the transfer of a fairly permanent solvent like stearic acid into the material.

Bone is often dyed in that way. There is no true dyeing of the bone, but there is a dyeing of the stearic acid. That is, it is a wax dye which penetrates the pores of the bone and is permanently there on the bone not as a dyeing of the bone, but as a dyeing of the stearic acid which is permanently dispersed throughout the bone.

In this case, perhaps we haven't a dyeing of the wood

at all, but we may have a dyeing of a complex solvent with new solvent and new penetrable properties that take the dye, move into the wood, and remain there perhaps as a permanent combination of your peculiar ester, plus the tannin of the wood, plus the resin of the wood, with entirely different penetrable and entirely different dye reactions than if, for example, you had mounted the Para Red in an entirely different solvent.

I admit it is a rather complex question. It does look rather contradictory when you say your solvent doesn't move through the wood, and that the solvent, plus the dye, does. I think we have to assume a modification of the solubility effect of your solvent by the constituents of the wood and the dye also modifying solubility. If you don't assume that the solubility is modified, I don't see how you are ever going to explain the apparent contradiction of the solvent not moving through the wood and the solvent, plus the dye, going through.

Chairman Freedman: Thank you.

Dr. Alexander: There is just one question I would like to ask: How do you know the solvent didn't go through the wood? (Laughter.)

That is what I say: You have to make a study of every particular case to find out what really happens. By the way, you can see here is the principle of the ultramicroscope. You can now see the dust particles traveling in the intense beam of this arc light, which has about 12 hundred candle power, even though the room is brilliantly lighted. If the room were darkened, the effect would be more striking.

Chairman Freedman: Are there any further questions?

Well, gentlemen, I believe you will all agree with me that we have just listened to a very enlightening talk which just scratched the surface of colloid chemistry, and yet, it opens up many vistas of thought to all of us. I know that my mind was very, very active during this entire session. I think that a good reason for that is the fact that while the subject itself is a very intricate and complex one (it may not be to Dr. Alexander, but it is to me), his homely means of expression, his examples which were so numerous, brought home to us in a manner such as I have seldom heard before the thoughts and messages that the speaker conveyed to us. It was because of the manner in which he delivered his talk that he was able to make so great an impression upon me and I am sure upon the rest of us.

I will entertain a motion, or I will take it upon myself to call for a rising vote of thanks to the speaker of the evening.

. . . A rising vote of thanks was extended to Dr. Alexander, the members arising and applauding . . .

. . . Announcements were made by Chairman Freedman at this point, and the meeting thereupon adjourned at ten o'clock . . .

NINETIETH RESEARCH COMMITTEE MEETING

THE ninetieth Research Committee meeting followed the Council meeting at the Engineers' Club of Boston, on Friday afternoon, October 19, 1934. Present were Chairman Louis A. Olney presiding, W. D. Appel, J. R. Bonnar, W. H. Cady, Hugh Christison, R. F. Culver, R. E. Derby, C. Z. Draves, W. C. Durfee, B. L. Hathorne, A. E. Hirst, E. C. Knaeble, H. F. Lawton, H. W. Leitch, J. G. Masson, Hans Meyer, W. R. Moorhouse, G. A. Moran, R. E. Rose, B. A. Ryberg. W. M. Scott, and H. C. Chapin.

The Chairman reported that a meeting of the Research Program Committee had been held during the morning, and gave an outline of the program of research projects being carried out under grants from the Textile Foundation.

The report of the Society of Dyers & Colourists' Committee on Standardizing the Methods of Testing the Fastness of Dyed Materials was brought before the meeting by the Chairman, with the request that the tests described therein be compared with corresponding tests of our Association by the sub-committees responsible.

The sub-committee on Rayon, represented by B. L. Hathorne, Chairman, was requested to confer with the committee of the Federated Textile Industries on rayon shrinkage tests. The Rayon committee was authorized to prepare a research program, and a report showing the extent to which the industry will cooperate in pursuing it.

The report of the sub-committee on Printing Pastes was presented by W. H. Cady, Chairman. The work of the sub-committee on Carbonization of Wool was described by Roland E. Derby, Chairman, and Bertil A. Ryberg, Research Associate. A report from the sub-committee on Action of Alkalies on Wool, drawn up at a recent meeting of the committee at the home of Alban Eavenson, Chairman, was read by William D. Appel. The report of the sub-committee on Light Fastness was presented by William H. Cady, Chairman. The sub-committee on the Determination of Fibers in Mixtures reported by letter from the Chairman, Claxton Monro. Hugh Christison, Chairman, reported for the sub-committee on Methods of Determining Oil, Soap, and other Extraneous Matter in Textile Materials. From Charles B. Ordway, Chairman, was received a letter regarding the plans of the sub-committee on Mercerizing. Ralph Hart, Chairman, reported by letter for the sub-committee on Methods of Analysis and Standardization of Sulfonated Oils. Howard D. Clayton, Chairman, reported by letter for the sub-committee on Shrinkage of Textiles. Hugh Christison, Chairman, reported for the sub-committees on Fastness Tests for Dyed Wool, and on Fastness to Perspiration. From the sub-committee on Fastness Tests for Dyed Cotton a report was presented by George A. Moran, Chair-

man. Dr. Scott discussed Standard Methods of Determining Sizing, Weighting, and Finishing Materials in Textiles, for the sub-committee headed by R. W. Hook, Chairman. Dr. Meyer demonstrated a simple device for measuring relative crocking tendencies of dyed materials.

Respectfully submitted,

H. C. CHAPIN, *Secretary.*

MEETING, NORTH CAROLINA STATE COLLEGE STUDENT SECTION

THE Student Section of the North Carolina State College had two former students as speakers at their meetings this past week.

Mr. James Black, now connected with the Ciba Company as salesman and demonstrator, gave a talk on nomenclature of dyestuffs, followed by an explanation of how money value of dyes is figured.

Mr. H. S. Bliven, past chairman of the Student Section of A.A.T.C.C, and graduate of 1934, spoke on his experience in the laboratory and dye house of the Judson Mills.

Both of these young graduates gave some information that was of much interest to the students present.

Respectfully submitted,

B. UZUNOFF, *Pro-Tem Secretary.*

FALL MEETING, SOUTHEASTERN SECTION

THE Fall Meeting of the Southeastern Section of the American Association of Textile Chemists and Colorists was held at the Piedmont Hotel, Atlanta, Georgia, on Saturday, November 10, 1934.

During the delicious repast that was served, we were delightfully entertained through arrangements made by the local committee in charge, Sam Clement, S. I. Parker and Jim White.

After dinner, the meeting was called to order by the Chairman, C. B. Ordway, and an interesting program, consisting of the following numbers, was presented.

B. A. Alexander, a representative of the Collins & Aikman Corporation, showed a film, "Velvet, the King of Fabrics." This was a most instructive picture, starting with the raw materials, and continuing through all the processes to the finished rugs and tapestries.

"The Photo-Electric Cell in Color Matching," was presented in a splendid way by Mr. Harvey, of the Engineering Department, Westinghouse Electric Co.

A very interesting discussion followed this paper.

Prof. W. H. Vaughan, Acting Head of the Engineering Experiment Station, at Georgia Tech, gave glimpses, through a moving picture, of the work in research that has been done by this Station. The experiments in the development of rayon from slash pine were of particular interest to the members of the Section.

A resolution was passed in favor of the Southeastern Section cooperating with the South Central Section in inviting the annual meeting of the A. A. T. C. C. to Chattanooga.

There being no further business, the meeting adjourned.

Respectfully submitted,

C. A. JONES,
Secretary

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MEETING, PHILADELPHIA SECTION

THE Philadelphia Section inaugurated the present season with a meeting on October 26th, in the Broadwood Hotel, Philadelphia.

During the business meeting a letter from Dr. Draves in relation to papers for the annual meeting was read as was a communication from the AMERICAN DYESTUFF REPORTER directing attention to the new News Item column.

The Secretary reported the Section's membership in relation to that of a year ago as:

	Oct., 1934	Oct., 1933	May, 1932
Active	159	151	...
Junior	17	12	...
Associate	16	15	...
Student	1	2	...
Corporate	4	5	...
Total less corporate	193	180	165
Applications pending	10		

Mr. Stringfellow directed attention to the fact that if the members of the Association acted collectively those attending the annual meeting in New York could secure substantial reductions in railroad transportation rates. He explained the rates for the different modes of transportation to New York and urged that the members who attended the New York meeting travel together by rail to enable the members from other sections to secure the reduced rates.

He was appointed by the Chairman to supervise arrangements for transportation and hotel accommodations and the Secretary was directed to communicate with the National Secretary to ascertain if the railroads transporting passengers to New York had been informed that the meeting was to be held.

Mr. Harold B. Dohner presented a brief resume of the most recent developments in textile assistants as reflected in recent U. S. Patents. Mr. Dohner is to present a similar resume at each of this season's meetings.

Mr. Eugene C. Knaeble, the Section's Councilor, presented a brief report of a Council and Research Committee meeting he had attended in Boston during the preceding week.

Following the business meeting, Dr. Wallace H. Coxe, of the Smokeless Powder Department of E. I. du Pont de Nemours & Co., Inc., presented an address on the subject of "Descriptive Ballistics."

His talk was illustrated by stereopticon slides and motion pictures.

The usual informal dinner preceded the meeting and was attended by 60 members and their guests. Sixty-four attended the meeting.

Respectfully submitted, CHARLES A. SEIBERT, *Sec'y.*

AMERICAN
DYESTUFF
REPORTER

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Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES
President

M D REESER
Secretary

H F. CRAWFORD
Treasurer

Subscription price: $5.00 per year; Canadian $6.80 foreign $6.00

Vol. XXIII December 3, 1934 No. 25

LOOKING BACKWARD

ON the front cover of our issue of December 5th, 1921 appeared an announcement of considerable significance which was as follows: "The section includes the initial appearance of the Proceedings of the American Association of Textile Chemists and Colorists which will become a regular feature of the REPORTER from this time forward. The matter covered in the present number includes the minutes of the organization meeting, the complete Constitution of the Association, an account of the first meeting of the Council, standing committees appointed, and a list of charter members." It is with a great deal of pride that the REPORTER continues to publish the Proceedings of the Association and that they still continue to be a feature of each issue.

In looking through the issue referred to above many interesting facts are brought to light concerning the beginnings of the Association. We learn that the inaugural meeting was held at the Engineers' Club in Boston, Mass. on November 3rd, 1921. The meeting was called to order by Louis A. Olney, chairman of the Organization Committee. He expressed the gratification of the committee over the enthusiastic response with which all their endeavors had been met and commented upon the fact that probably at no previous time had so many textile chemists and colorists gathered together upon a seriously minded purpose. He also explained that an earlier meeting had been held in New York the previous September at which time the organization committee had been appointed. The members of this general organization committee were as follows: Louis A. Olney, Chairman, Walter A. Hadley, Secretary, William D. Livermore, George A. Moran, Walter M. Scott, William R. Moorhouse, Robert E. Rose, William H. Cady, Frederic Dannerth and A. E. Hirst.

Among other business completed at this meeting was the acceptance of the REPORTER as the official organ of the Association and in this respect E. H. Killheffer, chairman of the committee on publicity and publication, reported: "I want to say, Mr. Chairman, the Committee, at the time we met, did consider other publications than this one, but it did not feel that there was any publication that was better." It is the sincere wish of the REPORTER that the feelings of the Association today continue in the same channel.

The report of the first Council Meeting (the report of the ninety-seventh Council Meeting appears in the November 19, 1934 issue of the REPORTER) considered among other matters: the formation of local sections in general and of a Providence section in particular (we learn later that the Rhode Island Section was duly formed); discussion as to status of junior members and junior branches and the matter of publication of the Proceedings of the Association.

The Constitution plays a major part in this issue as do the names of the charter members of the Association. The officers of the Association at this time were as follows: President, Louis A. Olney; Secretary, Walter E. Hadley; Treasurer, Winthrop C. Durfee. The Vice-Presidents were William D. Livermore and William H. Cady and the Councilors were James L. Amsden, Elmer C. Bertolet, Arthur E. Hirst, George A. Moran, William K. Robbins and Walter M. Scott.

The names of many of the above persons are still familiar to the members of the Association as they remain active in carrying out the purposes of the Association. On the eve of the Fourteenth Annual meeting of this body of chemists and colorists we thought it appropriate to review the activities of this first meeting. It must be gratifying to those who took part in this inaugural meeting to see the extent to which this organization has grown and what it has accomplished. It is particularly gratifying to the REPORTER to have been a part of this growth and to have recorded its accomplishments in its pages. The present officers are very ably carrying on the program originally designated by the first officers.

We wish to complement the persons who had the foresight and took upon themselves the necessary labors to organize the Association and also those who have since taken an active interest in its work and carried on. To the Association itself—*Congratulations!*

● 1935 SPRING WOOLEN CARD

The 1935 Spring Woolen Card, portraying forty-eight shades, has just been issued in a new and enlarged form to members of the Textile Color Card Association.

The swatches are over twice the size of those used on former woolen cards, making the new edition more comparable in appearance to the regular season silk card.

Due to the fashion significance of two and three color combinations, the Association has created an innovation in the form of black Color Masks, to be used in conjunction with the new woolen card, as well as the regular edition of the 1935 Spring Silk Card to be issued later.

The shades are arranged on these cards in special groups according to the latest color movements in fashion, so that by use of the masks, the smartest harmonies or contrasts are revealed. For example, if a two color combination is required, the mask captioned, "Twins" is used and its two windows are placed over any two adjoining colors which are arranged in vertical order. Thus, in some columns, "tone on tones" are indicated, while in other columns, distinct contrasts are secured.

"Triplets," the mask with three windows, is used if three color combinations are required. The windows are placed over any three colors running vertically. This method will disclose two shades of the same color family with one shade of a contrasting range, or three single shades of three different color families. "Singlets" is a mask with one window, used to isolate a color from its neighbors, so that its true individual character will be revealed. Printed on each mask are full directions for its application.

● TWENTIETH ANNIVERSARY OF A. S. T. M. COMMITTEE D-13

The series of meetings of Committee D-13 on Textile Materials held in New York City on October 17, 18 and 19 are considered among the most successful yet held by this committee. The meeting also celebrated the twentieth anniversary of the organization of the committee. A number of constructive actions were taken at the meeting some of which are indicated in the following paragraphs.

The scope of Section V on Hose, Belt and Numbered Duck of Subcommittee A-1 on Cotton and Its Products has been changed to cover all heavy cotton woven fabrics. Subcommittee A-3 on Wool and Its Products was divided into four sections as follows: Section I on Wool, Section II on Felt, Section III on Wool and Worsted Yarns and Section IV on Woolen Fabrics. The general chairman is G. E. Hopkins, Technical Director, Bigelow-Sanford Carpet Co., Inc., who is also chairman of Section I. J. F. Marshall, General Sales Manager, American Felt Co., is chairman of Section II; Fred Noechel, Head of Textile Laboratory, Botany Worsted Mills, of Section III; and A. G. Ashcroft, Product Engr., Alexander Smith and Sons Carpet Co., of Section IV.

Based on the reports of the respective subgroups in charge, the following recommendations were accepted at the meeting for submission to letter ballot of the Committee D-13 membership:

Proposed Methods of Testing:
Cotton Fiber Length and Length Distribution
Cotton Fiber Fineness
Cotton Fiber Immaturity Count
Strength of Raw Cotton
Shrinkage in the Laundering of Silk and Rayon Broad Goods

Revisions were recommended in the Standard Specifications for Textile Testing Machines (D 76-33). The changes provide for recognition of the constant specimen-rate-of-load machine as an approved type of tensile testing machine; the addition of a tolerance for testing machine speed; omission of reference to alignment pins; prevention of back-lash in dial pointer; and individual strand jaws. In the General Methods of Testing Woven Textile Fabrics (D 39-34) a change will be balloted upon by the committee involving a method of determining elongation for which an initial load of 6 oz. is specified, while other loads may be specified for particular materials.

The meeting took action to refer to the entire committee for approval a revision in the Tentative Definition of Direction of Twist. The proposed definition is as follows:

A yarn or cord has "S" twist if, when held in a vertical position, the spirals conform in slope to that of the central portion of the letter "S," and "Z" twist if the spirals conform in slope to that of the central portion of the letter "Z."

A number of papers were presented at the general meeting of the committee as follows:

Some Observations from a Study of Wool Flannels, Serges and Gabardines—Prof. Ethel Phelps, University of Minnesota.

Determination of Twist in Single Woolen and Worsted Yarns—Fred Noechel, Botany Worsted Mills.

Measurement of Acceptance or Rejection of Synthetic Fabrics by Pittsburgh Women—Prof. D. R. Craig, University of Pittsburgh.

Tht Principle of Probability in the Evaluation of Testing Results—Dr. I. J. Saxl, Waypoyset Manufacturing Co.

The committee's research program includes studies of the following: Measurement of thickness; diameter of drums for testing strength of cords; slippage of seams in cloth; shrinkage of silk and rayon cloth; fat determination in woolen materials; chemical tests for floor coverings; yarn standards.

D-13 Officers:

Chairman, H. J. Ball, Professor of Textile Engineering, Lowell Textile Inst.

Secretary, W. H. Whitcomb, 41 Norman Ave., Cranston, R. I.

● BOOK REVIEWS

The Handbook of Chemistry and Physics. 19th Edition. Chas. D. Hodgman, M.S., Editor-in-Chief, published by the Chemical Rubber Publishing Co., Cleveland, Ohio, 1934. Pages 1934. Price $6.00. Special price to Teachers and Students.

For twenty-one years this Handbook of Chemistry and Physics has been giving an increasingly valuable service to scientists and technical men, in that it combines in one volume accurate tables, formulas, and scientific data relating to chemistry and physics.

Constant revisions year by year have brought this 19th edition up to 1934 pages of the most up-to-date data procurable. One of the innovations of this edition is the division of the book into five sections of approximately equal size made plainly visible by inserting stiff colored paper upon which is printed a summary of the contents of that particular section. These five sections are as follows:

1. Mathematical Tables
2. Properties and Physical Constants
3. General Chemical Tables
4. Heat and Hygrometry, Sound, Electricity and Light
5. Quantities and Units—Miscellaneous Tables

Among the material which has been added to the 19th edition are new tables on X-Ray Crystallographic Data, determination of crystal structure and X-Ray analysis. Density of Moist Air, Heat of Combustion of Liquid Fuels, Solubility of Ammonia in Water, Fusibility Scale, Flame Spectra, Vapor Pressure of Carbon Dioxide and many others. In addition to this new material sixteen different subjects and tabulations have been completely revised, enlarged and brought up-to-date.

This volume is recommended to all who wish a combined handbook of chemistry and physics and this edition is so much more complete that it should replace earlier editions.

Practical Everyday Chemistry, H. Bennett, The Chemical Publishing Co., New York, 305 pp.

According to the preface of this book it is intended to offer to the reader information which will satisfy his curiosty as to the composition of various substances which are in common use. It is intended that the layman will develop an acquaintance with those products with which he is now familiar only by name.

The book contains formulae, written in simple language, which cover a multitude of products and include adhesives, alloys, anti-freezes, antiseptics, bleaches, cements, colors, disinfectants, dyeings, drugs, emulsions, fireproofing materials, greases, ink soaps, ink paints, polishes soaps and cleaners, stain removers, and many other articles of daily consumption.

Aside from its practical aspects the book offers much in the way of pleasurable information. Copies sell for $2 and may be obtained through this publication.

● GERMAN CHEMICAL EXPORTS

Exports of chemicals and allied products from Germany during the first half of 1934 held up well despite the acute shortage of exchange, contracting only 3 per cent from the corresponding period of 1933 and compared with a decline of 12 per cent in exports of all commodities from that country, according to a report from Consul Sydney B. Redecker, Frankfort-on-Main, made public by the Commerce Department's Chemical Division.

Total exports of chemicals and allied products, from Germany during the first half of the current year were valued at 333,500,000 marks, accounting for 16 per cent of Germany's total trade compared with 343,900,000 marks for the first half of 1933 when exports of these products accounted for 14½ per cent of the total. During the first half of 1932 only 12.8 per cent of Germany's exports consisted of chemicals, it was stated.

The principal items making up Germany's chemical and allied products exports during the first half of the year were heavy chemicals, 77,500,000 reichsmarks; dyestuffs and intermediates, 73,100,000; medicinal products, 50,600,000; nitrogen fertilizers, 26,700,000; and mineral pigments and colors, 25,800,000. These groups taken together accounted for 76 per cent of the country's total exports of chemicals and allied products. Other items of importance on the export list included photographic chemicals, explosives, paints and lacquers, and essential oils, the Consul reported.

European countries continued the best markets for German chemicals, taking 207,500,000 reichsmarks worth in the first half of the year, compared with 212,600,000 for the corresponding period of last year, and accounted for 61.8 and 62.2 per cent, respectively, of chemical exports to all countries during these periods. Latin American countries took 30,300,000 reichsmarks worth of German chemicals and allied products during the first half of 1934, and China, Japan, and British India absorbed more than 15,000,000 reichsmarks worth each, statistics show.

Germany's chemical exports to the United States during the first half of 1934 were valued at 19,200,000 reichsmarks against 21,300,000 reichsmarks for the corresponding period last year, and constituted 5.8 and 6.2 per cent, respectively, of that country's chemical and allied products exports to all countries.

● COLGATE BROADCASTS

S. Bayard Colgate, who at 36 is president of the company founded 128 years ago by his great-grandfather, recently made a plea for retention of the American system of fair competition when he addressed the public of the entire country in a broadcast that marked his debut on the air.

Recalling that the United States has successfully survived seventeen depressions in the century and a quarter since William Colgate launched what is now the Colgate-Palmolive-Peet Company, the speaker said:

"We can increase neither our national wealth nor our national income by curtailing production, raising prices and selling to fewer consumers. American industry has grown by constantly reaching out with lower prices for broader markets and thus has made available to the great masses of our people many things that are considered luxuries in other countries.

"Our country with 6.13 per cent of the population of the world has more automobiles, more telephones, more bathtubs, more life insurance than all the other countries in the world combined. And has this been accomplished by chiseling labor? Today an hour's work will buy five times as much in goods and services as it did 100 years ago, and the average weekly hours of work have been reduced 40 per cent. Even in normal times we work fewer hours per week than in any other country, and our wages per hour on the average are higher than those of any other country.

"I contend that until at least one other economic system has shown by furnishing a higher standard of living to the mass of its people that it is better than ours, we should stick to our own profit system of fair competition."

The problem of increasing costs to the point where the consumer stops buying, Mr. Colgate said, is a problem which both industry and government must face squarely and courageously.

"Taking our own company for example," he said, "when the depression came on we looked up our old friend the consumer, and asked him what he wanted and how he wanted it. He told us. He also reminded us that he was on a budget and suggested that we go easy on the price. We had confidence in him and voluntarily took less profit on each transaction to get the price down to the figure our consumer had in mind."

Mr. Colgate declared this procedure had proved constructive, and he predicted that through this and other sound policies the present depression will be conquered as others have been conquered before it.

● SANDOZ REPORTS

Alizarine Light Brown BL and *Alizarine Milling Blue SL* offered recently by Sandoz Chemical Works, Inc., are reported by the company to have been commented on very favorably by dyestuff users. They possess properties which are quite unique in that they are said to be extremely fast to light and for dyestuffs that may be dyed without chrome, are exceptionally fast to fulling; in fact they are said to compare favorably with all but the better chrome colors in fastness to fulling.

Where the desired shade cannot be obtained by a combination of these two colors, chrome colors may be combined with them as the shade of these dyestuffs is not altered by chrome.

It is claimed that both dyestuffs dye very level on "tippy" wool which makes them desirable for raw stock dyeing where light fastness is of importance. It is stated that they are also useful in deying worsted tops and either individually or separately give a combined fulling and light fastness of the highest order.

It is claimed that these dyestuffs have appealed especially to the manufacturers of woolen and worsted suitings, bathing suits, automobile fabrics, blankets, domestic and oriental rugs and a variety of others where their general all around fastness properties have been appreciated.

● SYNTHETIC ORGANIC CHEMICALS

The above is the title of a booklet which we mentioned in our issue of October 22nd and which had just been published by the Carbide and Carbon Chemicals Corp. A more detailed examination of the booklet reveals many interesting features.

This is the sixth edition of this booklet describing the Carbide and Carbon chemical products, Vinylite resins, Activated Carbon, Pyrofax and other hydrocarbon gases of high purity. Although many of these products are relatively new in a commercial sense, they have already found extensive use in widely diversified industries. Furthermore, new applications in which advantage is being taken of their many distinctive properties, are constantly being developed. Information regarding certain of the characteristics and uses of these compounds has only recently become available. The data given in this book are intended to outline some of their applications and so to present the important characteristics of the products that new uses will be suggested.

This booklet, with its yearly increase of new products, would seem to be gradually developing into a miniature primer on the subject of aliphatic organic chemicals. In the Sixth edition of "Synthetic Organic Chemicals" the products are grouped by families such as alcohols, acids, ethers, ketones, etc. There are some 11 of these embracing over 70 chemicals. About half of these products have been added since the last edition, including such important industrial chemicals as synthetic Ethyl Alcohol, Acetic Anhydride, Aceto Acetic Ester and others.

A new feature of this issue is a solubility table. In it are tabulated the solvent power of some 42 solvents for about a dozen industrially important oils and resins such as shellac, nitrocellulose, cellulose acetate, ester gum, etc. In addition to the description of the chemicals, the properties and uses of the Vinylite resins are outlined. There are also given the physical forms in which these resins are available, as well as the properties of the new Vinyloid resins which have been developed for the protective coating industry.

The properties of activated carbon are described as well as the part it is playing in the rapid strides that are being made in the fields of solvent recovery and air purification. The hydrocarbon chapter contains an excellent tabulation of the physical constants for practically all the

common hydrocarbon gases including Methane, Ethane, Propane and Butane as well as the unsaturated hydrocarbons, Ethylene, Propylene and Butylene.

Copies of this booklet are available upon request.

● GEIGY RELEASES

The Geigy Company, Inc. announces the following new releases of dyestuffs and sample cards.

Setacyl Direct Rubine B Conc. Powder—a clear bluish red to augment the Geigy list of Setacyl Direct Colors (Powder) for acetate yarns. It is said to have outstanding fastness properties and complete dischargeability in a 3% shade. It is claimed that this dyestuff has excellent solubility, good level dyeing qualities, extremely good fastness to calendering, water, stoving and light, good fastness to washing, acids, rubbing and perspiration and fair fastness to cross dyeing.

Sample Card No. 889—showing wool and acetate colors. Dyeing procedure is given and samples shown.

Sample Card No. 887 — showing wool with celanese effects and union goods with celanese effects. Dyeing methods are given and samples shown.

Sample Card No. 879-A—showing dyeings on woolen yarn which are said to be level dyeing and with outstanding fastness to light. Samples of dyeings are shown and a method of dyeing is given.

Erio Chrome Garnet L—a further addition to the Geigy line of Chrome colors and represents a yellow shade intended for the dyeing of piece goods, slubbing and raw stock. It is said to be level dyeing, readily soluble and to possess excellent all-a-round fastness properties. It is further stated that this dyestuff can be used either as a self shade or in combination and can be dyed according to either the afterchrome process or on a chrome mordant. By either of these methods it is claimed that the dyestuff will represent excellent money value.

Copies of above mentioned sample cards are available upon request.

● CHARLOTTE COLLOID MILL

The Chemicolloid Laboratories, Inc. announce the production of a small Charlotte Colloid Mill which they are offering at a moderate price. It is said to be the first mill of its kind which will operate consistently at a set speed of 3600 r.p.m. and yet perform the operation involved. All parts of the mill which come in contact with the material are of Monel metal. Other specifications are as follows: Weight—200 lbs., Motor—1 H.P., Inlet—¾", Outlet—½", water cooled material chamber, and cast iron construction except where the Monel metal is used. Further details are given in a bulletin which is obtainable upon request.

● POLARIZING MICROSCOPES

The above is the title of a new booklet issued by the Bausch & Lomb Optical Co. which gives detailed information concerning the polarizing microscope. The different types of microscopes under this classification are described and the uses for which each type is especially suited is indicated. Accessories for microscopes are also discussed. Copies of this booklet are available upon request.

● NATIONAL DYE

The National Aniline & Chemical Company releases a new dyestuff, *National Alizarol Azurine ECA,* an addition to their line of chrome dyes, which produces pure blues on wool when dyed afterchrome. It may also be applied on a chrome bottom or with National Alizarine Mordant by the meta-chrome process, but the shades so obtained are greener and duller than by the afterchrome method.

Fastness properties claimed for this dyestuff are as follows: excellent fastness to washing, fulling, potting, carbonizing, stoving, perspiration and rubbing. It is further stated that although the fastness to light is only fair, it is sufficient to permit the use of this dyestuff on raw stock, yarns and pieces for a great variety of purposes. Cotton, rayon and acetate are said to be left unstained.

● JAPANESE DYE PRODUCERS

Supported by a large and expanding domestic textile industry, Japan's coal-tar dye producers have made rapid strides during recent years, according to C. C. Concannon, Chief of the Commerce Department's Chemical Division.

At the end of 1932, he pointed out, a total of 16 dyestuffs companies had a paid up capital of 9,055,000 yen. As 189,870,000 yen of new capital was invested in the entire Japanese chemical industry in 1933, it is safe to assume, he declared, that a substantial portion of this amount was used for establishing coal-tar dye plants.

A report just issued by the Japanese Coal Tar Manufacturers' Association covering the year 1932 credited Japan with having 58 factories at the end of that year. A total of 440 different products, valued at 30,613,000 yen, were being produced in these plants giving employment to 4,010 persons, according to the report.

No details are available concerning all the items produced but the report mentions that 232 coal-tar dyes, 118 coal-tar intermediates, 55 synthetic medicinals, 16 perfume materials, and 19 "other" products were being manufactured at the end of 1932. Since that date, Mr. Concannon states, the manufacture of many other items has no doubt been undertaken.

A total of 42 plants were engaged in the manufacture of dyestuffs and intermediates, 13 were producing medicinal chemicals, 3 perfume and 3 "other," according to the report.

Statistics show that Japanese producers of coal-tar dyes are now supplying the bulk of the domestic demand and in addition are developing an export trade in these products. Production in 1933 totalled 19,804 metric tons compared with 9,659 tons in 1931; imports declined from 1,998 to 972 metric tons. Exports during these periods increased from 2,011 to 6,083 metric tons, it was stated.

OPEN FORUM

See previous issues for details of this department

New Question

21—We are experiencing some difficulty in detecting and determining any amount of supposedly present compounds of Avirols, Gardinol and Neomerpin AS, in scouring, finishing, and delustering agents.

We have found in some of these new products recommended for the above purposes to have present in them; chlorides, soda ash, and starches.

Please describe a method by which one can detect and if possible determine quantitatively their presence, in such as finishing, scouring and delustering agents.

I believe that this question may also be of some interest to many of our chemist readers.—**B. U.**

● GERMAN DYE EXPORTS

After several years of steady decline, German exports of coal tar dyes are increasing and as a consequence of increased activity in the German textile industry, domestic consumption is heavier.

A report from Consul Sydney B. Redecker, Frankfort-on-Main, made public by the Commerce Department's Chemical Division, states that exports of coal tar dyes from Germany during the first seven months of the current year totalled 18,707 metric tons, valued at 82,685,000 reichsmarks, compared with 15,091 metric tons, valued at 74,851,000 reichsmarks in the corresponding period of 1933.

While domestic consumption of dyestuffs in Germany has increased considerably since the beginning of 1934 it is anticipated that sales will decline during coming months as imported raw materials such as cotton and wool are becoming scarce owing to the insufficiency of foreign exchange required for their importation. This shortage of textile materials has already resulted in curtailed operations and reduced output, the report states.

German coal tar dyes are exported to all textile producing countries. Statistics show that of the $4,158,100 worth of coal tar dyes imported into the United States during the first 10 months of 1934, approximately half were shipped from Germany, it was stated.

● ARABOL BOOKLET

"Sulfonated and Emulsified Fatty Materials" is the title of a booklet which is being distributed by the Arabol Manufacturing Co. The subject matter is contained in a paper which was presented before the Piedmont Section of the A.A.T.C.C. and which was published in the May 7th issue of the AMERICAN DYESTUFF REPORTER. The paper was written and presented by John J. Sokolinski, Chief Chemist and Manager of the Textile Division of the above mentioned company. The following materials are discussed: tallow, sulfonated castor oil, stearamide emulsions, stearic acid and beeswax. There are also several attractive photographs, taken by the author, illustrating the text matter. Copies of this booklet are available upon request.

● 1935 SPRING SILK COLORS

Unusual new tints, featured as *The Regency Pastels*, provide a highly important color influence in the collection of 1935 Spring silk shades, which the Textile Color Card Association has just issued to its members through the confidential advance card.

This smart pastel theme, it was explained by Margaret Hayden Rorke, managing director of the color organization, derives its inspiration from the appealing shades in vogue during the English Regency (1811 to 1820), a period which will be strongly reflected in Spring fashions. Pastel tints will be smartly represented in the sports and evening mode and will take on a new significance in combination with darker and stronger colors.

The brilliant note in fashion finds its newest and smartest expression in *Peasant Colors*. These bold animated hues, which have high merchandising and promotional value, are inspired by the picturesque national costumes of European peasants. They will be particularly important in combination with other colors, including black.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED—By Philadelphia Textile graduate 31 years old, married, protestant. Experience—At present and for past 6 years, boss dyer in large plant using wool, cotton, rayon and acetate fibers; 2 years apprentice learning wet and dry finishing; 1 year apprentice at wool sorting,—also summer work in dyestuff laboratory. Would like position with opportunity for advancement. Write Box No. 832, merican Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED—Salesman by large converters of starches to sell these products to the textile and paper trade. Must be thoroughly familiar with this line. Reply Box No. 839, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

OPPORTUNITY—CHEMIST. One experienced in textile oils and finishes. There will be an opening in our company about the first of the year. List experience, by whom employed and salary expected. Reply to Box No. 840, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.